B.3.1.2 H-Area Acid/Caustic Basin (904-75G)

The H-Area acid/caustic basin is one of six such basins in the Reactor and Separations Areas. These basins are unlined earthen depressions nominally 15 meters long, 15 meters wide, and 2 meters deep.

History of Waste Disposal

See Section B.3.1.1. The H-Area basin remained in service until in-process neutralization facilities became operational in 1982.

Evidence of Contamination

Groundwater monitoring wells have not been installed around the H-Area basin.

Waste Characterization

Limited data are available pertaining to any sampling or monitoring program associated with the H-Area acid/caustic basin.

B.3.1.3 F-Area Burning/Rubble Pits (231-F and 231-1F)

The F-Area burning/rubble pits are in the northwest portion of the Plant, west of F-Area and east of Road C. The configuration of the pits is approximately that of a parallelogram, each being 84 meters long, 23 meters wide, and 3 meters deep.

History of Waste Disposal

See Section B.2.1.6. Rubble disposed of at this site reportedly includes concrete, metal, lumber, and telephone poles.

Evidence of Contamination

See Section B.2.1.6.

Waste Characterization

See Section B.2.1.6.

B.3.2 LOW-LEVEL RADIOACTIVE WASTE SITES

B.3.2.1 H-Area Retention Basin (281-3H)

TC The H-Area retention basin is southwest of the H-Area perimeter fence (Scott, Killian, Kolb, Corbo, and Marine, 1987). It is at the lip of a slope leading to a tributary of Four Mile Creek at an elevation of 81 meters. It is 36.6 meters long, 61 meters wide, and 2.1 meters deep. Its volume is 8.53×10^4 liters.

TC The basin is on the Four Mile Creek side of the water-table divide (Scott, Killian, Kolb, Corbo, and Marine, 1987). The groundwater beneath it migrates toward the tributary of Four Mile Creek that flows toward H-Area. The average water-table gradient from the basin to this tributary is 0.03 meter per meter.

The H-Area retention basin is fenced but not backfilled, and it is surrounded by vegetation.

History of Waste Disposal

The retention basins in the Separations Area were used from 1955 to 1973 (Scott, Killian, Kolb, Corbo, and Marine, 1987). The basins are currently not in use. TC These open, unlined basins provided temporary storage for potentially contaminated cooling water and contaminated storm water from the waste tank farms and, therefore, kept wastewater from discharging into nearby streams. When radioactivity was encountered in the cooling water or storm water, such water was immediately diverted from surface drainage streams to the retention basins. Leaks of process material to cooling water and spills of radioactive waste to the storm sewer could have caused the contamination. During the holding period, some water seeped into the ground. The exact quantities of water disposed of in the retention basins are unknown.

Evidence of Contamination/Waste Characterization

In 1977, researchers performed radiological surveys of soil and vegetation around the H-Area retention basins (Scott, Killian, Kolb, Corbo, and Marine, 1987). Radiation above guidelines was measured at levels up to 90 millirads per hour near the edge of the basin. TC Vegetation near the basin exhibited cesium-137 at 8200 to 8900 picocuries per gram and strontium-89 and 90 at 58,000 picocuries per gram. No guidelines are issued for vegetation. An area of approximately 930 square meters has shown levels of radioactivity.

B.3.2.2 F-Area Retention Basin (281-3F)

The F-Area retention basin is outside and south of the F-Area perimeter fence and east of Building 281-8F. The basin is in an area of level topography on the Aiken Plateau at an elevation of 82 meters above sea level. Surface drainage from the surrounding area flows to Four Mile Creek, about 1200 meters away. The slopes toward Four Mile Creek are very gentle in the vicinity of the basin, but they become progressively steeper approaching the creek. The basin is rectangular, with dimensions of 36.6 by 61 by 2.1 meters. Its volume is 8.53×10^4 liters (Scott, Killian, Kolb, Corbo, and Marine, 1987). TC

The retention basin is on the Four Mile Creek side of the water-table divide. Groundwater beneath the basin migrates toward the creek. The average water-table gradient from the basin to Four Mile Creek is 0.009 meter per meter.

History of Waste Disposal

The F- and H-Area retention basins have similar disposal histories (see Section B.3.2.1); however, F-Area was excavated to 0.6 meter below the original floor of the basin, backfilled with dirt, and covered with grass.

Evidence of Contamination/Waste Characterization

During the latter part of 1978, approximately 970 cubic meters of contaminated TC soil containing about 11.5 curies of cesium-137 and 0.5 curie of strontium-90 was removed from the F-Area retention basin and transported to the burial ground.

An analysis, performed in 1979, determined that most of the residual cesium-137 in the basin floor was in the top 30 centimeters of soil, while there were concentrations of strontium-89 and 90 at depths to 180 centimeters. Of the remaining basin soil, calculations based on core samples indicated that about 0.05 curie of cesium-137 and 1.3 curies of strontium-90 remain in the basin sediments.

B.3.2.3 Present Radioactive Waste Burial Ground (643-7G)

The present radioactive waste burial ground (643-7G) is between the F and H Separation Areas (Figure B-5). The burial ground is an area of approximately 61 acres consisting of trenches and greater confinement boreholes and pads used for the storage or disposal of low-level, intermediate-level, and transuranic (TRU) solid waste. The mixed waste management facility (643-28G), a site of approximately 58 acres used for the disposal of candidate mixed wastes, is completely within the boundaries of 643-7G. The total combined area (643-7G and 643-28G) is 119 acres. Section B.3.3.1 discusses the mixed waste management facility. This section discusses the history of disposal, evidence of contamination, and waste characteristics (Jaegge et al., 1987) at 643-7G.

History of Waste Disposal

The present burial ground (643-7G) has received waste generated after 1972. Bulky low- and intermediate-level wastes are disposed of in trenches 6 meters wide, up to 300 meters long, and 6 meters deep. The trenches are backfilled with a minimum of 1.2 meters of soil. These trenches are the shallow-land burial (SLB) type.

Since mid-1984, newly generated low-level waste has been containerized in metal boxes and stored in engineered low-level trenches (ELLTs). Transuranic waste contaminated to greater than originally 10, currently 100 nanocuries per gram is placed in containers and stored retrievably on concrete pads at ground level and covered with 1.2 meters of soil.

Evidence of Contamination

Groundwater contamination at the combined 643-7G and 643-28G area is monitored with 19 perimeter wells and 26 grid wells within the perimeter of 643-7G. The groundwater beneath the monitored portion of 643-7G and 643-28G contains an estimated 1 millicurie of nonvolatile beta emitters and 0.5 millicurie of alpha emitters. Tritium measurements suggest a total activity of tritium beneath the monitored area of 5600 curies.

The burials of tritium waste in the unmonitored eastern portion of 643-28G suggest that a plume of tritium will develop in the groundwater in that area and subsequently flow toward 643-7G.

Nonradioactive chemical species have been monitored in groundwater at 643-G and 643-7G (Jaegge et al., 1987). Detected constituents are mercury, cadmium and lead.

Waste Characterization

Examples of the materials that have been stored or might be disposed of in 643-7G include the following:

- Contaminated equipment
- Reactor hardware and resins
- Spent lithium-aluminum targets
- Incidental waste from laboratory and production operations
- Shipments from off the site

B.3.3 MIXED WASTE SITES

B.3.3.1 Mixed Waste Management Facility (643-28G)

The mixed waste management facility (MWMF) is near the F- and H-Area separations facilities (Figure B-5). With an area of approximately 58 acres, the MWMF consists of a number of individual trenches that were used for the disposal of candidate mixed wastes. The trenches are within the boundaries of a larger facility (643-7G) known as the radioactive waste burial ground. TE

History of Waste Disposal

The MWMF received wastes from 1972 to March 1986. Candidate mixed wastes are disposed of in SLB trenches that are generally about 6 meters wide and 6 meters deep and have variable lengths up to 500 meters. The trenches, separated by about 3 meters, were backfilled daily during landfilling activities. See Section B.3.2.3. TC

Evidence of Contamination

Hazardous constituents have been identified at the boundaries of 643-7G and 643-28G. However, it has not been determined which of the waste management facilities is the source of these constituents. A monitoring program has been proposed to determine the presence and extent of groundwater contamination. Monitoring was performed during the characterization of the combined radioactive waste burial grounds (643-7G).

Waste Characterization

Candidate mixed wastes placed in the MWMF trenches consist of scintillation fluids and waste oil. The oil originated from pumps in the tritium facilities and reactor areas. Before storage, the waste oil was placed in 208-liter drums containing an absorbent material. Other wastes stored include lead shielding, cadmium, and incidental waste from laboratory and production operations. The mobility and rate of migration of these wastes have not been determined.

B.3.3.2 Old Radioactive Waste Burial Ground (643-G)

The radioactive waste burial ground (643-G) is between the F and H Separations Areas (Figure B-5). The disposal site occupies a 76-acre area and is approximately 10 kilometers from the nearest Plant boundary. The following sections describe the history of waste disposal, evidence of contamination, and waste

characteristics at the site. Section B.3.2.3 discusses the newer burial ground (643-7G), which currently receives low-level radioactive wastes (Jaegge
TC et al., 1987).

History of Waste Disposal

This burial ground is a central site used for the disposal of solid radioactive waste.

The older burial ground began to receive waste in 1952 and was filled in 1972. It was divided into sections for accommodating various levels and types of radioactivity in waste materials: TRU alpha waste, low-level waste (alpha and beta-gamma), intermediate-level beta-gamma waste (intermediate- and low-level beta-gamma solid radioactive wastes are segregated according to radiation measurement), and waste generated off the site. The burial ground was operated in compliance with U.S. Atomic Energy Commission (AEC) regulations and DOE Orders regarding radioactive waste disposal. Inorganic constituents such as lead (used to shield a variety of waste forms), mercury (from gas
TE pumps in tritium facilities), and cadmium (from nuclear reactor control rods) have been placed in the burial ground.

Evidence of Contamination

Past SRP burial practice resulted in direct contact between waste and soil in near-surface backfilled trenches. The annual average gross alpha concentra-
TC tion for all but one well has been approximately constant and fairly low, 1 to 9 picocuries per liter (background level), since 1974. The average gross nonvolatile beta concentration increased in 1984 after having been fairly low and constant for the previous 5 years. Since 1974, the annual average gross nonvolatile beta concentrations have ranged from 13 to 76 picocuries per liter. One research well at the site remains considerably higher in gross alpha (231 picocuries per liter) and gross nonvolatile beta (15,453 picocuries per liter) activity than the other wells. The alpha and beta emitters present in this research well have been identified as primarily plutonium-238, plutonium-239, and strontium-90. The observed variations in concentration are under investigation to determine mechanisms.

Tritium is also found at the burial ground research wells but at much higher concentrations and in larger zones of contamination. The average tritium concentration rose in 1984 to 87.5 million picocuries per liter, more than twice the 1983 value, thus returning to levels observed in 1978, 1980, and 1981. Monitoring has also yielded evidence of nonradioactive chemical species. In 1984, a maximum concentration of 2.9 parts per billion of mercury was observed.

The estimated total activity of radionuclides in the groundwater beneath the 643-G burial grounds is 2.5 millicuries of alpha emitters, 16 millicuries of nonvolatile beta-gamma emitters, and 38,600 curies of tritium. As these data indicate, tritium, in contrast to alpha and nonvolatile beta emitters, is readily leached and moves freely with groundwater flow.

During the time the tributylphosphate-kerosene extraction solvents were stored in underground tanks, approximately 1600 liters of solvent were released to the groundwater as a result of tank leaks and process upsets. Some of the fission and activation products measured in monitoring wells are attributed to this source. Also, the decontamination of equipment with complexing agents might be responsible for the migration of nuclides to several research wells. See Section B.3.2.3.

Waste Characterization

Materials that have been disposed of at the burial ground include (1) contaminated equipment from the radiochemical Separations Area, (2) reactor hardware and resins, (3) spent lithium-aluminum targets, (4) oil from pumps in the tritium facilities and reactor areas, (5) mercury from gas pumps in the tritium facilities (approximately 9000 kilograms), (6) incidental waste from laboratory and production operations, (7) tritiated waste received from the Mound Laboratory, (8) plutonium process wastes from other DOE facilities, and (9) debris from U.S. military plane accidents.

Mechanisms that affect the mobility of radionuclides in groundwater are under investigation. The most likely mechanisms are (1) complex formation with organics, carbonate, and phosphate; and (2) competitive cation exchange with the soil, for groundwaters with high conductivity and high concentrations of various cations. Other conditions that might increase radionuclide migration are abnormal pH, low Eh or dissolved oxygen, and high iron concentrations.

B.3.3.3 F-Area Seepage Basin (904-41G)

Seepage basin 904-41G is one of three currently operating basins in F-Area (Figure B-5). Wastewater flowing to the basins enters basin 1 (904-41G) through a single underground pipe. It flows from basin 1 to basin 2 (904-42G) and then to basin 3 (904-43G) through underground pipelines. This section discusses the history of disposal, evidence of contamination, and waste characteristics common to all three operating basins (Killian et al., 1987a). TC

History of Disposal

Discharges from the F-Area separations facility began in 1955 to the basins. TC
Effluents include low-level radioactive and chemical wastewaters. The purpose of the basins is to provide a controlled release and appropriate decay time for tritium and to retain other radionuclides. The three F-Area seepage basins cover an area of approximately 5.5 acres and have a capacity of about 1.1×10^8 liters. Basin 1 has side dimensions of 27 by 84 meters and a capacity of about 8.9×10^6 liters. TC

Evidence of Contamination

One-meter soil cores have been collected from the bottoms of the F-Area seepage basins. The cores, which were collected at two or three locations per basin, were divided into 0.15-meter intervals for analysis of the 16 radionuclides and 25 cations and anions listed in Table B-7. Approximately 90 percent of the radionuclides, cations, and anions are contained within the top 0.3 meter of the basin soils. TE All radionuclides listed in Table B-7 except cerium-141 were observed in the soil cores. TE Curium-244, cobalt-60, cerium-144, ruthenium-103, and strontium-89 were present infrequently. Silver, beryllium, lead, selenium, tungsten, cyanide, and nitrites were not observed in the cores. Chromium, iron, fluorine, manganese, sodium, nitrate, and titanium were found frequently. The remaining cations and anions were observed less frequently.

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Table B-7. Parameters Analyzed in the F- and H-Area Basins Sediment-Characterization Study[a]

Radionuclides	Cations and anions	Cations and anions
Tritium	Arsenic	Nickel
Cobalt-60	Barium	Selenium[b]
Strontium-89, -90	Beryllium[b]	Silver[b]
Niobium-95	Bismuth	Sodium
Zirconium-95	Boron	Tin
Technetium-99	Cadmium	Titanium
Ruthenium-103, -106	Chromium	Tungsten[b]
Iodine-129	Copper	Zinc
Cesium-134, -137	Iron	Nitrates
Cerium-141,[b] -144	Lead[b]	Cyanide
Thorium-232	Lithium	Fluoride
Uranium-233, -235, -238	Mercury	Nitrites[b]
Plutonium-238, -239	Manganese	
Americium-241		
Curium-244		
Promethium-147		

TC

[a]Source: Killian et al., 1987a.
[b]Not found.

In March 1985, a well downgradient from the seepage basins was sampled for RCRA Appendix VIII parameters. This well was believed to be the most contaminated downgradient well. The only detected parameters were the following: selenium, barium, cadmium, and nickel. Since 1981, the highest alpha, nonvolatile beta, and tritium concentrations in monitoring wells have been 2700 picocuries per liter, 160,000 picocuries per liter, and 36 million picocuries per liter, respectively.

TE In the fall of 1984, 13 new groundwater monitoring wells were installed in four clusters at the F-Area seepage basins. The well clusters are screened in the Barnwell, McBean, and Congaree aquifers. The wells were sampled first in March and April of 1985. The analyses show that, as expected, the highest levels of contamination are in the shallow water-table wells.

TC Strontium has been emerging in Four Mile Creek from the F-Area basins since 1967. The amount entering the creek annually is about 2 percent of the groundwater strontium inventory in F-Area. Maximum strontium-90 concentrations in groundwater and emergent seep lines range from 0.014 to 0.34 microcurie per liter (Christensen and Gordon, 1983). Alpha activity in groundwater between the basins and Four Mile Creek in the Separations Areas is attributed mainly to uranium discharged to the basins, plus a small amount of natural radioactivity. Alpha concentrations in F-Area groundwater and seep lines range from 1.4×10^{-5} to 6.5×10^{-3} microcurie per liter. Only tritium, strontium-90, and uranium have been detected routinely in groundwater between seepage basins in the Separations Areas and Four Mile Creek in concentrations greater than 10 times the natural background levels.

In 1968 and 1969, intensive groundwater monitoring studies of nitrate levels found values ranging from 100 to 300 milligrams per liter in F-Area, as opposed to concentrations of 3 milligrams per liter in natural groundwater. Values of pH were found to be in the range of 4 to 6 in the basin vicinity. Results of an April 1984 terrain conductivity survey at the F-Area seepage basins to determine areas of potential contaminant migration correlate well with the nitrate studies performed in the late 1960s; however, a new plume was suspected west of basin 3.

Waste Characterization

The primary sources of the effluent being discharged to the basins from the F-Area separations facility are the nitric acid recovery unit, the general-purpose evaporator overheads, the two waste tank farm evaporator overheads, and the overheads of several other process evaporators. Retention basin transfers are another source. The monitor upstream from basin 1 measures flows to the F-Area seepage basins and takes wastewater samples proportional to these flows. The average daily flow into the basins for 1985 was 411,000 liters per day. TC

The F-Area separations facility routinely has released wastewater containing nitrates to the seepage basins since startup in 1955. Release rates vary, but they average 234,300 kilograms per year, as measured from 1961 to 1970, in 1975, and in 1983.

F-Area operations sometimes use mercury to aid in dissolving aluminum-alloy fuels. The sodium hydroxide used in F-Area also contains trace amounts of mercury as an impurity. Most of the mercury is retained in high-level waste tanks, but some is discharged to the basins via evaporator overheads. An estimated 380 kilograms of mercury-contaminated wastewaters were released to the F-Area basins between 1955 and 1970. Between 1971 and the end of 1984, 61 kilograms of mercury were released to the basins.

In a 1983 influent characterization study, the waste stream entering the F-Area seepage basins was sampled nine times between September and December to obtain the concentrations of various chemical constituents. Table B-8 lists the results of that study. For the radionuclides, the number of curies conveyed to the seepage basins in 1982 and 1983 and the volume of effluent were used to calculate the average concentrations. TE

B.3.3.4 F-Area Seepage Basin (904-42G)

See Section B.3.3.3. Basin 2 (904-42G) is 27 by 161 meters with a capacity of 1.7×10^7 liters. TC

B.3.3.5 F-Area Seepage Basin (904-43G)

See Section B.3.3.3. Basin 3 (904-43G) has dimensions of 94 by 219 meters and a capacity of 8.3×10^7 liters. TC

B.3.3.6 F-Area Seepage Basin - Old (904-49G)

Seepage basin 904-49G in F-Area (Figure B-5) measures 59.4 by 91.4 meters. A berm about 1.5 meters wide at the top and about 12.2 meters wide at the bottom

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Table B-8. F-Area Seepage-Basin Influent Characteristics[a]

Constituent	Average concentration (mg/liter except for pH)	Constituent	Average concentration (pCi/liter)
Sodium	790	Am-241	308
Calcium	0.5	Ce-141	1,540
Iron	1.7	Ce-144	1,540
Ammonium	24	Cm-242	154
Barium	0.01	Cs-134	6,200
Aluminum	0.78	Cs-137	62,000
Nitrate	1220	I-131	15,400
Carbonate	131	Nb-95	62,000
Nitrite	2	Pm-147	7,690
Chloride	1.2	Pu-238	308
Sulfate	4.6	Pu-239	308
Phosphorus	2.2	Ru-103	30,800
pH	2.93	Ru-106	308,000
Lead	0.12	Sr-89	3,080
Mercury	0.004	Sr-90	6,200
Chromium	0.013	Tritium[b]	1.02×10^{8} [c]
Copper	0.010	U-235	2080
Fluoride	1.5	U-238	2080
Zinc	0.3	Zr-95	62,000

TC

[a]Source: Killian et al., 1987a.
[b]Not included in this specific study; concentration is an approximation based on 1983 data.
[c]Rounded value.

separates the basin into two compartments. The following sections describe TC the history of waste disposal, evidence of contamination, and waste characteristics at the seepage basin (Odum et al., 1987).

History of Waste Disposal

Basin 904-49G, constructed in 1954, was the first seepage basin used on the Plant. It received wastewater from F-Area from November 1954 until mid-May 1955. The seepage rate from this basin proved to be inadequate to handle the increasing volumes of wastewater from F-Area separations operations; thus, three additional basins were constructed in 1955 and routine use of the 904-49G basin was stopped. The basin has been used intermittently since 1955 to divert rainfall runoff or process water from Outfall F-2. Preceding sections discussed the three basins that replaced 904-49G.

Currently, the basin has an accumulation of rainwater with a maximum estimated depth of less than 45 centimeters. Before the summer of 1985, very little water remained in the basin; the total estimated volume was less than 567,000 liters. Current estimates indicate that the basin is seeping very slowly and acting much like a "wet weather pond," with the level increasing during rainy weather and decreasing during periods of low rainfall and high evaporation.

Evidence of Contamination

Recent sediment samples have been collected from the basin. Water and mud TC samples were collected from 41 different but unknown locations throughout the basin in June 1955. Four monitoring wells have been drilled around the basin; the most recent was installed in late 1984 and sampled during the first quarter of 1985. Sampling results for these wells indicate the presence of conductivity, turbidity, barium, chromium, copper, manganese, lead, zinc, fluoride, nitrate, gross alpha, and gross beta. Statistically significant differences between upgradient and downgradient wells for pH, conductivity, nitrate, barium, manganese, sodium, lead, gross alpha, and gross beta were observed.

Waste Characterization

See Section B.3.3.3.

During the operation of basin 904-49G, the wastes would have been sampled for radioactivity. Much of the waste probably was transferred directly to the seepage basin regardless of its chemical content.

The total radioactivity discharged to the basin has been estimated at 1.78 TC curies. This estimate was based on gross alpha and gross beta measurements and discharge volumes. Estimates of nonradioactive chemical releases (Table B-9) range from less than 19 kilograms of copper and 8 kilograms of nitrite to TE about 27,000 kilograms of nitrate.

B.3.3.7 H-Area Seepage Basin (904-44G)

Seepage basin 904-44G is one of four seepage basins in H-Area (Figure B-5). Currently, basins 1 (904-44G), 2 (904-45G), and 4 (904-56G) are in operation. Basin 3 (904-46G) has been inactive since 1962. The wastewater flowing to the basins enters through a single underground pipeline into basin 1. It travels from basin 1 to basin 2 and then to basin 4 through underground pipelines. This section discusses the history of disposal, evidence of contamination, and waste characteristics common to all four basins (Killian et al., 1987b). TC

History of Waste Disposal

The operating H-Area seepage basins have received hazardous and low-level TC radioactive wastewaters from the H-Area separations facility. The purpose of these basins is to provide a controlled release and appropriate decay time for tritium and to retain other radioactive materials in the soil. The four H-Area basins cover an area of approximately 13.8 acres. Discharges to basins 1, 2, and 3 began in 1955. In 1962, discharges to basin 3 stopped and the use of basin 4 began. Basins 1, 2, and 4 have a total capacity of about 1.4×10^8 liters at overflow conditions. Basin 1 has side dimensions of TC 27 by 73 meters and a volume of 4.2×10^6 liters.

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Table B-9. Estimated Nonradioactive Chemical Releases to Basin 904-49G[a]

Cation/anion	Release (kg)
Ammonium	29
Calcium	193
Magnesium	93
Sodium	1,111
Iron	550
Copper	<19
Aluminum	72
Lead	<72
Zinc	180
Chloride	53
Nitrite	7.9
Nitrate	27,000[b]
Sulfate	886
Phosphate	48
Chromium	<72

TC

TC

[a]Source: Odum et al., 1987
[b]Rounded value.

Evidence of Contamination

Several studies performed at the F- and H-Area seepage basins to characterize the soil indicate that cesium is retained well by sediments at the Plant, and that none has migrated far enough to be detected in groundwater between seepage basins in the Separations Areas and Four Mile Creek. Plutonium is retained higher up in SRP soils than cesium; sampling of F-Area basin 3 soil in 1971 to a depth of 3.0 meters showed that more than 99 percent of the plutonium is retained in the top 20 centimeters of soil, with a maximum concentration of 1.7 nanocuries per gram.

One-meter soil cores have been collected from the bottoms of the H-Area seepage basins. Cores collected at two to five locations per basin were divided into 15-centimeter intervals for analysis for 16 radionuclides and 25 cations and anions (Table B-8). Approximately 90 percent of all the detected radionuclides, cations, and anions except tritium and nitrate are contained within the top 0.3 meter of soil. With the exceptions of cerium-141, and zirconium-95, all radionuclides listed in Table B-8 were detected in the soil samples; ruthenium-103 was detected in only two samples. With the exceptions of beryllium, cadmium, and selenium, all cations and anions listed in the table were detected in the soil samples; silver, arsenic, cyanide, tungsten, and mercury were detected in only a few samples.

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TC

Quarterly groundwater monitoring, in compliance with RCRA and SCHWMR, began in the first quarter of 1982 with seven water-table wells near the H-Area seepage basins. An evaluation of the data for the first five quarters shows that the following parameters are probable groundwater contaminants because of their elevated levels in the basin influents and the consistency of groundwater data: pH, specific conductivity, total dissolved solids, mercury, sodium, nitrate, gross alpha, gross beta, and radium.

Groundwater monitoring for radioactivity parameters has been performed since Plant operations began. Results of alpha measurements for the past several years have shown that the highest concentrations (1.1 to 49.0 picocuries per liter) of alpha emitters are near basins 1 and 2. The highest nonvolatile beta concentrations (48 to 8500 picocuries per liter) are near and downgradient from basins 1, 2, and 3. Tritium concentrations are highest (1 million to 50 million picocuries per liter) near and downgradient from basins 1, 2, and 3.

In the fall of 1984, SRP installed 21 new groundwater monitoring wells in six clusters at the H-Area seepage basins to characterize contaminant migrations. The well clusters are screened in the water-table, Barnwell, McBean, and Congaree aquifers. Regular quarterly sampling began in March and April 1985. Samples were analyzed for tritium, nitrate, sodium, chromium, cadmium, and mercury. The analyses show, as expected, that the highest levels of contamination are in the shallow water-table wells. However, at one well, elevated levels of tritium, nitrate, and sodium were detected in the Congaree aquifer beneath the green clay. According to the results from the other wells screened in the Congaree, the green clay is a significant barrier to vertical contaminant migration. TE

Only tritium, strontium-90, and uranium have been detected routinely in groundwater between the seepage basins in the Separations Area and Four Mile Creek in concentrations greater than 10 times the natural background. Beta activity in groundwater at H-Area is attributed mostly to strontium. Although tritium moves at the same velocity as the groundwater, strontium moves slower than the groundwater because of the ion-exchange characteristics of the soil. Maximum strontium-90 concentrations in groundwater and emergent seep lines range from 5.5×10^{-5} to 1.8×10^{-3} microcurie per liter. Alpha activity in groundwater between the basins and Four Mile Creek in the Separations Areas is attributed mostly to uranium discharged to the basins, plus a small amount of natural radioactivity.

In 1968 and 1969, intensive groundwater monitoring studies of nitrate levels found values ranging from 100 to 250 milligrams per liter at H-Area, compared with concentrations of 3 milligrams per liter in natural groundwater. Also, pH values were found to be in the range of 4 to 6 in the basin vicinity. Results of an April 1984 terrain conductivity survey at the H-Area seepage basins to determine areas of potential contaminant migration correlate well with nitrate studies conducted in the late 1960s.

Special studies have been performed to characterize any potential transport of mercury from the H-Area seepage basins. Most of the mercury released to the basins is accounted for in the basin soil. However, data on mercury in soils from the outcrop along Four Mile Creek, in bottom sediments, and in suspended solids from the creek show that mercury from the H-Area basins is migrating into the creek, but in extremely small quantities. The only measurement of the outcropping of mercury into Four Mile Creek, made in 1971, showed 0.53 gram per day above the outcrop region and 0.89 gram per day below the outcrop, indicating that the basins were contributing about 0.36 gram per day. In a 1984 study, mercury was not observed in the water column at Four Mile Creek sites downstream from the F- and H-Area seepage basins. All mercury concentrations at the Four Mile Creek sites were less than 0.2 part per billion.

Waste Characterization

Primary sources of the wastewaters being discharged to the basins are the nitric acid recovery unit overheads, the general-purpose evaporator overheads, and the overheads of the two waste tank farm evaporators. Other sources of effluent are the cooling water from the tritium facilities, the water transferred from the retention basin, and the wastewater from receiving basins for offsite fuel. The Trebler monitor upstream from basin 1 measures flows to the H-Area seepage basins and takes wastewater samples proportional to these TC flows. The average daily flow into the basins for 1985 was 577,000 liters per day.

TE Table B-10 summarizes an influent characterization study completed in 1983. The waste stream entering the H-Area seepage basins was sampled 11 times between September and December of that year to determine the concentrations of those chemicals listed in the table. For each radionuclide, the number of curies sent to the seepage basins in 1982 and 1983 and the volume of effluent were used to calculate the average concentration.

The H-Area separations facility routinely has released wastewaters containing nitrates to the seepage basins since startup in 1955. Nitric acid is the major source of nitrates released to the basins. Release rates vary, but they average 220,000 kilograms per year, according to measurements made from 1961 to 1970, in 1975, and in 1983.

Typically, the F- and H-Area basins also receive 90,800 kilograms of sodium hydroxide annually. Before mid-1982, 5450 kilograms of phosphoric acid and 544 kilograms of sodium dichromate were sent to the H-Area basins annually. Sodium hydroxide is present as a result of resin regeneration operations in H-Area. Phosphoric acid and sodium dichromate, used in lithium-aluminum target cleaning, are now sent to the waste tank farm evaporator rather than being discharged directly to the seepage basins.

The estimated cumulative chromium release to the H-Area basins from January 1981 through July 1983 is 740 kilograms. Chromium concentrations in wastewater going to the H-Area basins have been recorded since October 1980.

B.3.3.8 H-Area Seepage Basin (904-45G)

TC Basin 2 has side dimensions of 36 by 140 meters and a capacity of about 1.1×10^7 liters. See Section B.3.3.7.

B.3.3.9 H-Area Seepage Basin (904-46G)

TC Basin 3 has side dimensions of 87 by 152 and 133 by 148 meters and a capacity of about 8.1×10^7 liters. See Section B.3.3.7.

B.3.3.10 H-Area Seepage Basin (904-56G)

TC Basin 4 has a capacity of about 1.3×10^8 liters. See Section B.3.3.7.

Table B-10. H-Area Seepage Basins Influent Characteristics[a]

Constituent	Average concentration (mg/liter, except pH)	Constituent	Average concentration (pCi/liter)
Sodium	17.6	Am-241	13
Calcium	28.0	Ce-141	3,333
Iron	5.1	Ce-144	17,333
Zinc	3.1	Cm-242	6.7
Ammonia	8.0	Cm-244	6.7
Barium	0.08	Co-58	6,670
Potassium	1.0	Co-60	6,670
Aluminum	3.2	Cr-51	33,300
Manganese	0.560	Cs-134	10,000
Magnesium	1.3	Cs-137	60,000
Nitrate	538.0	I-131	3,333
Carbonate	47.0	Nb-95	13,300
Nitrite	1.0	Pm-147	10,000
Chloride	1.1	Pu-238	60
Sulfate	3.9	Pu-239	40
Fluoride	0.1	Ru-103	50,000
Silicon	6.3	Ru-106	50,000
Phosphorus	0.6	Sb-124	1,333
pH	2.37	Sb-125	1,333
Lead	0.18	Sr-89	3,300
Mercury	0.043	Sr-90	6,670
Chromium	0.072	Sr-95	6,670
Copper	0.43	Tritium[b]	9.6×10^{8}[c]
		U-235	33
		U-238	33
		Zn-65	6,670
		Zr-95	6,670

[a]Source: Killian et al., 1987b.
[b]Not included in this specific study; concentration is an approximation based on 1983 data.
[c]Average value based on 1985 data.

B.3.4 MAJOR GEOHYDROLOGIC CHARACTERISTICS

The information in Appendix A related to regional geohydrology was developed from investigations at these waste sites. In this geographic grouping, the Middendorf/Black Creek (Tuscaloosa) consists of two sandy aquifers separated by a confining bed of sandy clay. The Ellenton Formation acts as a confining bed above the Middendorf/Black Creek, although there are sandy parts of the Ellenton that will produce water. Below the Middendorf/Black Creek, a bed of dense clay acts as a confining bed. Locally, the Congaree Formation is 22 to 26 meters thick and consists of well-sorted sands with layers of clay. A pisolitic-clay zone defines the basal Congaree, and the green clay marks the boundary between the McBean and Congaree Formations. The McBean Formation has average thicknesses of 21 and 17 meters in H- and F-Areas, respectively. As described in Appendix A, the McBean consists of an upper clayey sand zone and a lower calcareous sandy clay zone. However, logs on the lithology in the vicinity of F-Area indicate that there is little calcareous material in the lower McBean (Killian et al., 1987a). The basal Barnwell Formation consists of a discontinuous tan clay zone, which acts as a semiconfining layer between the McBean and Barnwell Formations in some portions of the area. The thickness of the tan clay ranges from 2 to 4 meters. The local water table is generally within the Barnwell Formation, although the Barnwell yields limited quantities of water because of the large quantity of fine-grained sediments. The lithology of the Hawthorn Formation is similar to that of the Barnwell, and the two are considered a single hydrostratigraphic unit. Although the Hawthorn lies above the water table, local layers of low permeability occasionally cause perched water tables. Some studies have identified perched water tables at F-Area, 4 to 6 meters below the ground surface and extending 45 meters south toward Four Mile Creek (Killian et al., 1987a).

The vertical-head relationships for wells near the Burial Ground, shown in Figure B-6, are typical of other waste sites in this geographic grouping. The hydraulic pressure in the Congaree is the lowest in the natural hydrologic system at this location. Thus, water flows to the Congaree from both above and below.

The permanent water table at F-Area is about 18 meters below the ground surface, but at H-Area it is only 5 to 8 meters below the surface. Figure B-7 is a water-table map that is based on measurements made in June 1982. The natural discharge from the water table is to Upper Three Runs Creek and its tributaries, and to Four Mile Creek. The water-table divide between the two major creeks bisects the combined 643-7G and 643-28G area.

Hydrologic characteristics of the sediments in the Barnwell, McBean, and Congaree Formations in F- and H-Areas have been determined in a number of laboratory and field tests (Killian et al., 1987a,b). Table B-11 lists the results of small-scale pumping tests. A comparison of the values for hydraulic conductivity in Table B-11 with other values (Killian et al., 1987a,b) shows that a range of at least two orders of magnitude is reasonable for all three formations.

B.3.5 ONGOING AND PLANNED MONITORING

Groundwater monitoring is proceeding at 14 of the 17 waste management facilities in the F- and H-Area geographic grouping. Well-water samples are analyzed quarterly for RCRA and SCHWMR parameters at hazardous and mixed waste management facilities. Typically, the wells are monitored for gross alpha, gross nonvolatile beta, and tritium at low-level waste management facilities. In this geographic area there are 241 wells used to monitor groundwater. DOE plans additional wells to obtain better definition of subsurface conditions and contaminant transport.

Waste site characterization programs have been completed at some of the waste management facilities and are being implemented at others. Characterization generally includes representative sampling of the waste, sampling of the soil and sediment under the waste site, and sampling of the soil and sediment around overflow ditches and process sewers.

Table B-11. Results of Small-Scale Pumping Tests[a] TE

Pumping well	Transmissivity (m^2/day)	Thickness (m)	Hydraulic conductivity (m/day)	Screened zone[b]	Location
HC 2F			0.55	UB	H-Area
H 54	2.3	13.0	0.18	LB	H-Area and Road E
ZW 4	3.6	4.9	0.73	LB	North of Burial Ground
HC 2E			0.19	LB	H-Area
HC 6B			0.13	LB	H-Area
HC 4B			0.070	LB	H-Area
BGC 1D			0.11	LB	Burial Ground
G 28			0.16	LB	Burial Ground
F 73	6.7	14.0	0.49	UM	Road F at Road 4
H 64	9.3	12.0	0.76	UM	H-Area along Road E
F 55	4.9	14.0	0.37	UN	North of Burial Ground
HC 1C			0.29	UM	H-Area
HC 3D			1.7	UM	H-Area
HC 9B			0.46	UM	Northeast of H-Area
HC 13B			0.027	UM	H-Area
HC 8C			0.15	UM	North of Burial Ground
HC 7B			0.040	UM	East of Road F
HC 4A			0.11	UM	H-Area
BGC 1C			0.030	UM	Burial Ground
F 66	0.89	7.0	0.13	LM	Road F at Road 4
H 53	6.5	13.0	0.49	LM	H-Area seepage basin
F 60	2.6	12.0	0.21	LM	F-Area seepage basin
F 65	6.1	10.0	0.61	LM	West of F-Area
HC 6A			0.073	LM	H-Area
FC 1B			0.014	LM	F-Area
HC 3A			0.79	C	H-Area
FC 2A			0.37	C	F-Area
HC 8B			0.37	C	North of Burial Ground

[a]Source: Jaegge et al., 1987. TC
[b]Key: UB, Upper Barnwell Formation; LB, Lower Barnwell Formation; UM, Upper McBean Formation; LM, Lower McBean Formation; C, Congaree Formation.

TE Table B-12 lists the representative monitoring wells at each waste management facility, the site investigations that have occurred, and the results of groundwater, soil, and vegetation monitoring.

B.4 R-AREA WASTE SITES

This geographic grouping is approximately 6 kilometers east of H-Area. As shown on Figure B-8, the grouping contains R-Reactor, which has been on standby status since 1964, and waste sites that are typical of SRP reactor areas. The area drains primarily to Par Pond, to the southeast. The boundaries of this geographic grouping are defined by the areas of influence assigned to the reactor seepage basins, the burning/rubble pits, and the acid/caustic basin.

B.4.1 HAZARDOUS WASTE SITES

B.4.1.1 R-Area Burning/Rubble Pits (131-R and 131-1R)

The R-Area burning/rubble pits are near the central portion of the SRP, south of R-Area and Road G. Each site is roughly rectangular, being approximately 72 meters long, 10 meters wide, and 3 meters deep.

History of Waste Disposal

See Section B.2.1.6.

Evidence of Contamination

No groundwater contamination has been observed to date in the four wells associated with these sites. See Section B.2.1.6.

Waste Characterization

Limited data are available on the extent of contamination and characteristics of the wastes involved at this site. Most of the data have been gathered via groundwater monitoring. Data collected to date indicate no contamination
TC (Huber, Johnson, and Marine, 1987).

B.4.1.2 R-Area Acid/Caustic Basin (904-77G)

The R-Area acid/caustic basin is one of six such basins in the Reactor and Separations Areas. These basins are unlined earthen depressions nominally 15 meters long, 15 meters wide, and 2 meters deep.

History of Waste Disposal

See Section B.3.1.1.

Evidence of Contamination

See Section B.3.1.1.

Waste Characterization

See Section B.3.1.1.

B.4.2 LOW-LEVEL RADIOACTIVE WASTE SITES

B.4.2.1 R-Area Bingham Pump Outage Pit (643-8G)

Bingham pump outage pit 643-8G is one of three inactive pits located outside the perimeter fence of R-Area (Figure B-8). Pits 1 (643-8G), 2 (643-9G), and 3 (643-10G) occupy approximately 460, 380, and 1270 square meters of land, respectively. TC This section discusses the history of disposal, evidence of contamination, and waste characteristics of all three R-Area Bingham pump outage pits (Pekkala, Jewell, Holmes, and Marine, 1987a). TC

History of Waste Disposal

Normally, all radioactive solid waste generated in the reactor areas is sent to solid waste burial ground 643-G/643-7G. An exception to this practice was made during 1957 and 1958, when the reactor areas initiated major modifications to their primary and secondary cooling water systems. The outages became known as the "Bingham pump outages." The radioactive waste generated in R-Area during the outages was surveyed, and solid waste with very low levels of or no surface contamination was buried in the outage pits. No pumps are buried in these pits. Subsequently, the outage pits were backfilled with clean soil. Waste with higher levels of contamination was sent to the radioactive solid waste burial ground.

The Bingham pump outage pits have been inactive since 1958; vegetation has grown uncontrolled over the sites. In 1970, radioactivity in samples of vegetation from the surface of the pits was compared with activity in vegetation growing at the SRP perimeter. Radioactivity in vegetation growing above the outage pits was elevated, although still very low. TE

Evidence of Contamination

No monitoring wells have been installed at the outage pits. No core sampling has been conducted there.

Waste Characterization

The pits contain construction equipment such as pipes, cables, ladders, drums, and boxes of miscellaneous hardware (Fenimore and Horton, 1974). At the time of burial, this waste had a radiation level of less than 25 milliroentgens per hour, and no alpha activity was noted. A conservative estimate of the activity buried in R-Area is 1 curie. Table B-13 lists the estimated inventories of this activity at the time of burial and at present. TE Radioactive decay since the waste was placed in the pits has reduced the inventories of cobalt-60, promethium-137, and ruthenium-103 and 106 to about 5 millicuries. Only cesium-137 and strontium-90 are expected to be present in measurable amounts.

TE

Table B-13. Estimated Radionuclide Inventory in Bingham Pump Outage Pits in R-, K-, L-, and P-Areas[a]

Radionuclide	At burial (Ci)	At present (mCi)
Cobalt-60	0.172	5
Strontium-90	0.112	60
Cesium-137	0.414	220
Promethium-147	0.172	0.1
Ruthenium-103, -106	0.130	1×10^{-6}

TC [a]Source: Pekkala, Jewell, Holmes, and Marine, 1987a.

B.4.2.2 R-Area Bingham Pump Outage Pit (643-9G)

Bingham pump outage pit 643-9G is the smallest of three inactive pits outside the R-Area perimeter fence (Figure B-8). Section B.4.2.1 discusses the history of disposal, evidence of contamination, and waste characteristics of all three pits.

B.4.2.3 R-Area Bingham Pump Outage Pit (643-10G)

Bingham pump outage pit 643-10G is the largest of the three inactive pits outside the R-Area perimeter fence (Figure B-8). Section B.4.2.1 discusses the history of disposal, evidence of contamination, and waste characteristics of all three pits.

TE B.4.2.4 R-Area Reactor Seepage Basins (904-57G, 904-58G, 904-59G, 904-60G, 904-103G, and 904-104G)

TE Six inactive and backfilled reactor seepage basins lie outside the R-Area perimeter fence (Figure B-8). Table B-14 lists their physical dimensions. The basins were constructed by excavating below grade and backfilling around the sides at grade level to form earthen dike walls. The depths varied according to estimated needs. The basins did not overflow; rather, water was released to the environment by evaporation and seepage. This section discusses the history of disposal, evidence of contamination, and waste characteristics of all six R-Area seepage basins (Pekkala, Jewell, Holmes, and Marine, 1987b). TC

History of Waste Disposal

Since 1957, earthen seepage basins have been used routinely and almost exclusively at the SRP for the disposal of low-level radioactive purge water from the reactor disassembly basins. This water purge is necessary to keep the tritium concentration in the disassembly-basin water at a level that ensures safe working conditions. Fourteen seepage basins in the reactor areas have received disassembly purge water (Stone and Christensen, 1983). Six of these basins are in R-Area. TE

Table B-14. Locations and Dimensions of R-Area Reactor Seepage Basins[a] TE

Basin	Building	Volume (m^3)	Dimensions (L x W x D, m)
1	904-103G	2.0×10^3	120 x 9 x 3
2	904-104G	2.0×10^3	40 x 14 x 3
3	904-57G	1.7×10^3	90 x 9 x 3
4	904-58G	2.1×10^3	93 x 11 x 3
5	904-59G	2.3×10^3	90 x 12 x 3
6	904-60G	6.2×10^3	150 x 14 x 5

[a]Source: Pekkala, Jewell, Holmes, and Marine, 1987b. TC

In R-Area, basin 1 went into service in June 1957 and began receiving low-level radioactive purge water. Beginning in November 1957, the R-Area seepage basins received approximately 200 curies of strontium-90 and 1000 curies of cesium-137 after the failure of an experimental fuel element during a calorimeter test in the emergency section of the disassembly basin. A large portion of this radioactivity was contained in basin 1. (Basins 2 through 6 went into operation after the incident.) Basin 1 was deactivated and backfilled in January 1958 because of surface outcrop and leakage to an abandoned sewer system. In 1960, basins 2 through 5 were deactivated and backfilled. The ground surface above the five basins was treated with herbicide and covered with asphalt. In addition, a kaolinite dike (down to the clay layer) was constructed around basin 1 and the northwest end of basin 3 to contain lateral movement of the radioactive contamination. Basin 6 was last used in 1964 and was backfilled in 1977. TC TE

Evidence of Contamination

Table B-15 lists the results of analyses of soil in and beneath the backfilled basins in R-Area. Five soil cores were collected in basin 1. One core each was collected from basins 2, 3, 4, and 5. Except for that from basin 3, the cores were centered on the zone beneath the basin that exhibited the highest radiation levels. The maximum radiation level was found in a narrow zone near the bottom of the backfilled basin; only minimal migration occurred below this interface. TE

Cesium-137 was the only gamma-emitter detected in the R-Area basins. As indicated in Table B-16, a maximum concentration of 8000 nanocuries per gram of soil (dry) was found in a segment of the core taken near the inlet discharge of basin 1. The greatest concentration of strontium-90, 41 nanocuries per gram, also was found in basin 1. According to radioassay results from a limited number of soil samples, basin 1 contains approximately 90 percent of the cesium-137 and 50 percent of the strontium-90 in the basin system. TE

Groundwater monitoring at the R-Area reactor seepage basins began in 1958, when 39 wells were drilled. Strontium-90 was first detected in groundwater shortly after the basins received purge water from the emergency section of the disassembly basin following the failure of an experimental fuel element in a calorimeter test in November 1957. Because of the differing stratigraphy of TE

TE

Table B-15. Radionuclides in R-Area Reactor Seepage Basin Soils [nCi/g soil (dry)][a]

Basin	Cesium-137, max.	Strontium-90, max.
1	8000	41
2	810	12
3[b]	0.34	<0.1
4	23	0.07
5	27	2.1

TC

[a]Source: Pekkala, Jewell, Holmes, and Marine, 1987b.
[b]Soil sampled above maximum zone of contamination.

TE

Table B-16. Radioactive Releases to R-Area Reactor Seepage Basins (Ci)[a,b]

Isotope	Release
Tritium[c]	2.0×10^{3}
Cobalt-60	7.2×10^{-2}
Strontium-90	1.0×10^{2}
Ruthenium-103, -106	5.5×10^{-8}
Cesium-137	4.7×10^{2}
Promethium-147	2.0×10^{-3}
Plutonium-239	3.0×10^{-1}

TC

[a]Source: Pekkala, Jewell, Holmes, and Marine, 1986b.
[b]Values cumulative through 1985; values decay-corrected.
[c]*Most tritium believed to have left* basins via atmosphere or groundwater.

the soils in which the basins were excavated, rapid movement of radioactivity from the basins to the groundwater was confined to the north end of basin 3 and the east end of basin 5.

In 1975, a substantial increase in strontium-90 activity (3400 picocuries per liter) occurred in a groundwater monitoring well on the east side of basin 1. Investigation revealed that the source of the contamination was migration through a construction sewer line that had been abandoned after the completion of R-Area. The sewer line traversed the basin 1 area. Additional wells were installed in 1976 and 1977 southeast of basin 1, but no further movement of contamination has been observed.

Only negligible amounts of tritium are believed to remain at the R-Area basins. Normally, significant amounts of alpha-emitting nuclides are not discharged to reactor seepage basins. However, the basin system in R-Area might have received a small amount of plutonium in 1957 as a result of a fuel element failure during a calorimeter test. The estimated amount of plutonium discharge to the R-Area basins is 3×10^{-1} curie. Essentially all of this plutonium would remain as current inventory.

Waste Characterization

Although many different radionuclides have been discharged to the R-Area reactor seepage basins, almost all of the radioactivity is due to tritium, strontium-90, and cesium-137. Table B-16 lists the inventory of radionuclides released to the seepage basins (corrected for radioactive decay through December 31, 1984). No significant amount of chemical contaminants is believed to have been discharged to the seepage basins. TC TE

Table B-17 lists yearly purge volumes from 1957 through 1964, when R-Reactor went on standby status.

Table B-17. Total Volume of Water Purged to R-Area Reactor Seepage Basins (liters)[a] TE

Year	Release
1957	6.813×10^6
1958	6.015×10^6
1959	7.570×10^5
1960	7.570×10^5
1961	1.136×10^6
1962	8.500×10^5
1963	1.136×10^6
1964[b]	7.570×10^5

[a]Source: Pekkala, Jewell, Holmes, and Marine, 1987b.
[b]R-Reactor has been in standby status since mid-1964.

B.4.3 MAJOR GEOHYDROLOGIC CHARACTERISTICS

Waste sites in the R-Area geographic grouping are on the Aiken Plateau near the topographic divide between the headwaters of Mill Creek (a tributary of Upper Three Runs Creek) to the north and the drainage to Par Pond to the east. Site-specific geohydrologic information is not available for this area; however, this EIS assumes that the subsurface geology is similar to that near F- and H-Areas (Appendix A), where much of the geohydrologic data on the SRP has been collected. A possible difference between the two areas is the vertical-head relationships of the Congaree and Middendorf/Black Creek (Tuscaloosa) Formations, as shown in Figure B-9. Recent evidence suggests that the vertical head relationships have changed and that the head reversal in the H-Area may currently be absent (Bledsoe, 1987). (See Figure A-7.)

Figure B-9 shows that the head in the Middendorf/Black Creek is lower than that in the Congaree for the general area of the R-Area geographic grouping, whereas in the central portion of the Plant a head reversal exists between the Middendorf/Black Creek and Congaree (higher head in the Middendorf/Black Creek). Consequently, contaminants could enter the Congaree from R-Area waste

TC sites and migrate into the Middendorf/Black Creek aquifer (Pekkala, Jewell, Holmes, and Marine, 1987b). The head difference map is constructed by subtracting two piezometric maps for which data are somewhat sparse. Thus, the map is useful for indicating general areas of expected head relationships, but it might not be accurate on a site-specific basis.

Figure B-10 is a map of the local water table constructed from data on monitoring wells near R-Area. The natural discharge from the water table is to Mill Creek and several unnamed tributaries of Par Pond. The depth to the water table from the ground surface ranges from 6 to 9 meters near the R-Area seepage basins. The hydraulic gradient toward Mill Creek ranges from 0.006 to 0.009 meter per meter. (See the Glossary.)

B.4.4 ONGOING AND PLANNED MONITORING

Groundwater monitoring is proceeding at 9 of the 12 waste management facilities in the R-Area geographic grouping. Well-water samples are analyzed quarterly for RCRA and SCHWMR parameters at hazardous waste management facilities. Typically, the wells are monitored for gross alpha, gross nonvolatile beta, and tritium at low-level waste management facilities. At least 56 wells in this geographic area are used to monitor groundwater in the vicinity of the 12 facilities. DOE plans additional wells to obtain a better definition of subsurface conditions and contaminant transport.

Waste site characterization programs have been completed at 7 of the 12 facilities and are being implemented at 2 others. Characterization generally includes representative sampling of the waste, the soil and sediment under the waste site, and the soil and sediment around overflow ditches and process sewers.

TE Table B-18 lists the monitoring wells at each waste management facility, the site investigations that have occurred, and the results of groundwater, soil, and vegetation monitoring.

B.5 C- and CS-AREA WASTE SITES

This geographic grouping is near the center of the Plant, a short distance south of F- and H-Areas. As shown in Figure B-11, it is actually two separate but closely spaced groupings, one formed by waste sites near C-Reactor and the other containing sites in and around the Central Shops (CS) Area. Tributaries to Four Mile Creek drain most of the area. The boundaries of this grouping are formed primarily by burning/rubble pits and the Ford Building seepage basin.